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Title page

From ambition to action: How to achieve integration in omni-channel?

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Abstract

The paper aims to identify how companies can enhance their omni-channel activities through improved data management and integration. Multiple case studies of ten leading UK companies are conducted by using multiple sources of data, including interviews, archival documents and expert focus groups. The case companies are manufacturers and retailers in the clothing, food, and Fast-Moving Consumer Goods (FMCG) sectors. A thorough list of challenges in the implementation of omni-channel

systems is generated and a number of propositions on enablers and barriers to omni-channel data integration are recommended. Our findings emphasise the importance of automating and standardising data capturing and sharing methods, and centralising data storage among companies and channels, which lead to improved efficiencies. They also indicate that omni-channel systems should be responsive to the choices of customers, and integration of the information systems of logistics service providers and their buyers is crucial in making omni-channels more efficient and consumer-responsive.

Keywords: Omni-channel, integration, data management, enablers, barriers

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Abstract

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1. Introduction

Today, businesses and consumers have various options for managing their material and information flows across product supply and demand networks. Those options, including home-delivery, click-and-collect and mobile shopping, are generally known as retail channels (Pei and Yan, 2015) and the use of a number of them for selling products, known as 'multiple channels', has become a new norm nowadays (Zhang et al., 2010). Achieving reliable and consistent flows of material and information in multiple channels demands a thorough network to link and coordinate processes, technologies, and businesses throughout all different channels for each product; this network is called 'omni-channel' (Brynjolfsson et al., 2013). Omni-channel aims to enhance customer experience across channels by providing a uniform and seamless view of the product, and by maintaining the brand value, irrespective of the channel (Liebmann, 2013).

Omni-channel is considered as a complex network, which includes many entities and several interactions among them (Saurin et al., 2013). Therefore, it underlines the vital role of data management and integration for operations performance of omni-channel, which is typically determined by coordination among marketing, sales, fulfilment, delivery and return activities (Marchet et al., 2018; Welker et al., 2008). Data integration is emphasised as a crucial factor for omni-channel in the literature, while it is studied by focusing on aspects including: data sharing among websites, stores and manufacturing firms (Li et al., 2018); availability of online and offline data on inventory, customer, delivery, and price (Park and Kim, 2019); channel choice breadth, channel service transparency, and content and process consistency (Shen et al., 2018); and confidentiality among channels, frequent communication of logistics information with Third-Party-Logistics companies (3PLs), mechanism of information use, and confidentiality with 3PLs (Song et al., 2019).

The literature mainly assumes that once a deep understanding of omni-channel data integration is developed, companies will implement it seamlessly. However, in reality companies are still struggling in achieving omni-channel targets (Kumar et al., 2017). This highlights a demand for further studies to identify the barriers and enablers of omni-channel data integration (Xu and Jackson, 2019). Recent pressures towards digitalisation and online presence have also led to demand for further research to explore the role of data and data management in omni-channel (Bell et al., 2015; Li et al., 2015). As an example, Zhang et al. (2018) recommend a more explicit view on omni-channel integration through specific types of integration (i.e. integrated promotion, product, price, transaction, order fulfilment, and customer service), however, they go no further to elaborate the way those integrations can be implemented in omni-channel. Also, Kembro et al. (2018) and Kembro and Norrman (2019) emphasise the demand for more studies on integrated information systems to support complicated material flows and inventories in omni-channel.

To fill parts of these gaps, a motivational question for this research is "how can companies improve their omni-channel data integration?" Accordingly, this study explores the data management and integration in omni-channel, by answering its main research questions: "What are the barriers and enablers of omni-channel data integration?"

The basic definition of 'data integration' in the research questions is borrowed from the well-established literature as: "combining data residing at different sources, and providing the user with a unified view of these data" (Lenzerini, 2002).

This research pursues a qualitative approach based on ten case studies of leading UK companies in clothing, food and FMCG sectors.

The outcomes are propositions, which mainly address a number of key enablers and barriers to omni-channel systems, including data synchronisation, integration and adjustability, which are defined and formalised in detail later. This paper particularly points out data capture and

data sharing as the main enablers for omni-channel data integration. It also shows how the omni-channel's data management adjustability to customers' needs, and extending it to manufacturers and logistics services, could enable omni-channel data integration. Moreover, this research indicates how the lack of data standardisation and centralisation would prevent omni-channel data integration being realised and achieved properly.

Therefore, the main contribution of this paper is identifying the influencing factors, in the forms of enablers and barriers, for omni-channel data integration. The outcomes of this research would lead the omni-channel literature to a departure from narrower views of multiple touchpoints for customer to a more holistic framework for data integration in omni-channel. As a practical contribution, the findings would assist retail managers to make more informed decisions on moving towards or enhancing omni-channel systems.

In the following sections, first a review of the literature is provided. Then, the methodology chapter introduces the data collection and data analysis processes applied in this study. Next, the findings are presented, followed by discussions and conclusions.

2. Literature review and theoretical ground

2.1. From multi-channel to omni-channel

What is known as omni-channel today is the outcome of a long-term evolution of various sales, marketing, distribution, and e-commerce innovative initiatives. For many years, retailers have tried the idea of multi-channel (Bartels, 1965), when they have been expanding communication and sales channels with customers, beyond the conventional physical stores, to reach more customers and increase revenue. The multiple channels, however, perform separately and independently (Beck and Rygl, 2015; Duffy, 2004), while competition among channels for the same product (known as 'channel cannibalisation') is inevitable as a result of no inter-channel coordination (Piotrowicz and Cuthbertson, 2014). To mitigate the multi-

channel pitfalls, various attempts have been made towards improving interactions and synchronisations among channels – for example see Berger et al. (2006) and Yan et al. (2010) for cases of connecting conventional and e-commerce channels (online-offline interlink). Those works lead to forming the new concept of 'cross-channel', where channels of product delivery and customer service are coordinating more, leading to reduced inter-channel conflicts, and better synergies for higher sales and more efficient operations (Avery et al., 2012; Cao and Li, 2015). Cross-channel systems then move forward towards achieving a broader view of all channels (Brynjolfsson et al., 2013), where customer can move from one channel to another seamlessly, and product and service providers have a full view of all channels and can interact with them easily (Verhoef et al., 2015). Such a system is called 'omni-channel', where any member of the system can trigger full channel interaction and have total inter-channel visibility (Beck and Rygl, 2015) throughout the customer shopping journey, i.e. in pre-purchase, purchase and post-purchase stages (Lemon and Verhoef, 2016). This kind of business configuration is typically recognised as a complex system (Saurin et al., 2013) – a network with several diverse entities and multiple interactions among them, which are typically non-deterministic and have non-linear characteristics.

A key capability widely recommended to manage complex systems is resilience or adaptability (Dekker, 2011), which refers to the ability to adjust the system's performance so that the system can virtually continue its normal operation when unpredictable changes with non-linear impacts occur. In the omni-channel context, data management and integration are key mechanisms, which can support the required adaptability and resilience – something much beyond multi-channel needs. Data management and integration can contribute to handling the changes with intra/inter-channel impacts prior to, during, or after their occurrence, by storing and sharing data across channels in both prescriptive (e.g. advising alternative delivery channels in case of any disruption in a delivery channel) and predictive

(e.g. updating multi-channel demand forecasts according to the latest unpredictable changes of demand in one channel) ways (Bradlow et al., 2017).

2.2. Omni-channel integration

The literature around omni-channel has emphasised a number of key features of data integration, including connecting organisations and channels (Cao and Li, 2015); engaging customers in the shopping and fulfilment processes (Lim et al., 2012); synchronising the operating model in which all of the company's channels are aligned (Schramm-Klein, 2011) and interacting with each other (Zhang et al., 2010); and providing customers with a convenient shopping experience (Blázquez, 2014). Omni-channel integration mainly tries to link various operations and objects, including promotion, sales, distribution, delivery, and return of products, to provide a unified and consistent service across all its different channels (Saghiri et al., 2017). The vitality and benefits of integration, as a core feature of omni-channel systems, have been studied and underlined in the literature in terms of increased operational performance (Seggie et al., 2006), more efficient product distribution and delivery (Hübner et al., 2016), and improved customer service quality (Herhausen et al., 2015; Zhang et al., 2018). Zhang et al. (2010) also explore the synergies achieved through integration across channels including: sharing market information and decisions, leveraging resources and physical assets, cross-channel promotions, cross-channel customer interaction, and wider product and price comparisons.

Omni-channel integration is in line with the three levels of physical, application and business integrations, introduced by Chen et al. (2015): at the physical level, stock keeping points and flows in different channels should be linked and coordinated; at the application level, information flows and databases should communicate properly; and at the business level, various channel processes and business models should be coordinated. Beside this hierarchical view of integration, in order to make sure that the whole omni-channel system

offers consistent services and a single view of products (in terms of purchase data, stock availability, inventory locations, despatch timing and delivery information), different entities of an omni-channel system should be fully integrated (Oh et al., 2012). The literature addresses various aspects of omni-channel integration based on: the entities that need to be integrated, e.g. website, physical store and manufacturer (Li et al., 2018); performance indicators such as on-time delivery and adequate inventory which need integrated planning (Park and Kim, 2019); the breadth and depth of inter-channel integration, measured by channel choices, channel service transparency, and content and process consistency (Shen et al., 2018); or more thoroughly based on the areas that require integration, such as promotion, product, price, transactions, order fulfilment and customer service (Zhang et al., 2018), as detailed in Table 1.

[Insert Table 1 here]

As evident from the omni-channel integration types (Table 1), data management and integration are core in omni-channel integration and execution (Li et al., 2015). For example, it is crucial that the entity generating the product data (e.g. manufacturer) and the entities using the product data (e.g. marketing and retail teams) apply the same structure and format to the data, and use compatible data exchange systems. Hence, access to 'appropriate data' in multiple channels can facilitate the evaluation of products, processes and promotions, and support the decisions on the choice of channels (Lim et al., 2012). Taking the existing literature into consideration, what we know about omni-channel integration is all about its necessity and significance, while the enablers for and barriers to it are yet to be explored.

3. Methodology and research design

Research into omni-channel is emerging and calling for exploratory research leading to elaboration of the phenomenon (Hübner et al., 2015; Saghiri et al., 2017). This research adopts an inductive multiple case study research design. The case study method can lead to generating in-depth understanding about a complex phenomenon, answering 'why' and 'how' questions, through developing extensive descriptions (Yin, 2014). It provides a strong base for theory building, making it suitable for developing fields such as omni-channel (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Verhoef et al., 2015). Studying multiple cases, compared to single case studies, can lead to generating more generalisable and robust outcomes (Stake, 2013). Therefore, multiple case studies are considered by the researchers as the most suitable approach for this research.

Ten major UK manufacturing and retailing companies in the clothing, food, and FMCG sectors are selected to be studied, due to their importance and value in the local and global markets as well as their fast transition towards online sales. The value of the UK clothing retail, including footwear and accessories, was £60.8bn in 2018 and is forecasted to increase to £76.1bn by 2023 (Mintel, 2018a). Share of online sales in the clothing market was £19.01bn in 2018 and is forecasted to rise by 72.5% by 2023 to £32.8bn. The grocery sector, i.e. food and FMCG, was worth £176.7bn in 2018, and is forecasted to rise to more than £200bn by 2023 (Mintel, 2018b). Online is a fast-growing section within the grocery market, which is forecasted to continue its increase in market share in the future (Mintel, 2018b; 2019).

All the selected companies studied in this research are among the key players in their sectors. Furthermore, they have an established strategy for developing their omni-channel systems and all provide products through different channels to their customers, including in-store, online, click-and-collect and home-delivery. Another reason for selecting these companies is

that they have been facing challenges in integration of their channels and the associated data management issues. Therefore, studying these companies can lead to providing novel and interesting insights for this research. The studied companies are listed in Table 2.

[Insert Table 2 here]

The unit of analysis (Yin, 2014) for case studies is the 'omni-channel system' of each company. The initial and subsequent outcomes of the research are discussed with experts, including senior experienced researchers and practitioners, and also with the participants in three focus groups (see 3.1.1). This helped the researchers to make the unit of analysis within each case distinct and bounded, and to validate the results of the study (Carter et al., 2015; Yin, 2014).

3.1. Data collection

The chronological order in which the data collection sources were used for this study is: (a) the first focus group meeting; (b) the interviews; (c) documentation and archival records reviewed through the study period (after identifying the case companies); and (d) the second and third focus group meetings.

Table 3 summarises the data collection sources and their contribution in developing the propositions of the study in chronological order.

[Insert Table 3 here]

Miles et al.'s (2013) recommendations for creating a case study database for proper storing and sorting of data are followed. The data sources are introduced in detail in the next sections.

Table 4 shows the data sources provided by all the companies who participated in this study.

[Insert Table 4 here]

3.1.1. Focus groups

The participants were practitioners, each having more than 15 years of experience in supply networks data management field, from Companies K and L. Company K is world-leading in implementing data capture and data sharing technology and standards (e.g. barcode, RFID and EDI) for end-to-end data exchange and integration in global omni-channel systems. Company L is a UK leading firm providing research and consultancy services to major European companies. They are familiar with the technical details and feasibility aspects of omni-channel integration and data management solutions. The combination of a team of experts from these two companies provided valuable insights for the researchers, helping them to validate the findings of the research and to receive feedback on the outcomes.

The first meeting, with two researchers and eight experts, took place before starting the interviews. The second meeting, with two researchers and seven experts, was after conducting the interviews with companies, enabling the researchers to share the insights from the interviewees and to receive feedback and additional information from the experts about the discussed topics. The final meeting, with two researchers and eight experts, was conducted in order to present the findings of the research and the propositions generated by the researchers and to receive feedback on them. Therefore, the majority of the focus group participants attended all three sessions. Throughout the meetings, one researcher moderated

the meeting and the other took notes. After the focus group meetings, the researchers met to analyse the notes and identify the main themes of discussion based on the group consensus (Kitzinger, 1995). The list of participants at the focus groups is shown in Table 4.

3.1.2. Interviews

After making initial contacts with the ten case companies, 11 managers were introduced as the most knowledgeable people in their organisations on the omni-channel systems and the related integration and data management aspects. Nine of the respondents (from eight companies) participated in face-to-face and telephone interviews. The interviews were conducted in a semi-structured format, and each interview lasted for 90 to 120 minutes. Two respondents from two companies sent their completed interview guide form with detailed answers via email, because after receiving the interview guide they realised the need to consult with their colleagues to ensure they provided accurate answers to the questions.

The interviews were recorded and transcribed to ensure data accuracy. All the interview transcripts and written answers were coded using NVivo, leading to identification of the main themes in the qualitative data (Yin, 2014). The coding process is explained in the data analysis section. The list of respondents and the way of providing information by them are shown in Table 4.

The interview discussion guide had three main sections:

i. leading to understand the businesses of the companies, their channels and their omni-channel systems;
ii. creating an understanding of the challenges of managing the omni-channel systems of the companies by focusing on the integration and data management aspects; and
iii. leading to identifying solutions for the companies' challenges and providing propositions in relation to those solutions.

The interviews were very informative, by providing interesting details about the operations of companies, the ways through which they were managing the demands on their different channels, and the issues they were facing in relation to integration by enabling seamless flows of material and information thorough their omni-channel system. This information was not possible to be achieved via any other source. The interviewees' insights about the solutions, e.g. data capturing and data sharing technology, which they had used for addressing their challenges and their plans for advancing their omni-channel systems in the future, significantly contributed to the findings and propositions of this study.

Follow-up emails and telephone calls were made to ensure that the provided information was accurately understood by the researchers.

3.1.3. Documentation

As secondary sources of evidence, documentation in different formats (Flick, 2018; Stake, 2013) including press articles about the studied companies, company reports available on their websites, internal reports and white papers, and annual reports has been used for completing the dataset required for conducting the analysis and also for triangulating the data collected through primary sources (see Table 3). The documentation was coded using the same format as the interview transcripts.

3.2. Data analysis

Within-case and cross-case analysis of the data (Eisenhardt, 1989; Miles et al., 2013) was conducted, leading to shaping the propositions of the study, as explained below:

First, descriptions (including tabular displays and figures) of each case were written based on the interviews' transcripts and documentation. It familiarised us with each case and helped us identify the unique patterns related to the omni-channel systems of each of the studied

companies. Specifically, it led to providing us with knowledge about the issues that the companies are coping with in terms of integration and collaboration between different entities and channels through their omni-channel systems, and the complexity and visibility issues. The keywords derived from the literature used for coding the interview transcripts and documentation for each case are: 'integration', 'data management', 'data sharing', 'data mismatch', 'complexity', 'visibility' and 'collaboration'. These keywords are defined in Table 5.

[Insert Table 5 here]

For identifying reliable cross-case patterns, following the guidelines by Eisenhardt (1989) and Yin (2014), we identified similarities and differences across the cases. We used matrix displays, using a spreadsheet containing the codes on one dimension and the quotes relating to each case on the other dimension (Kaufmann and Denk, 2011; Miles et al., 2013).

Through careful analysis by two researchers via six brainstorming sessions, the initial ideas for research propositions emerged and gradually took shape. In this stage the generated propositions were generic. For example, one of the themes was that "track and trace in omni-channel systems is an important issue which demands collaboration among different companies". Through the refining process, such initial propositions became more specific and also a group of propositions merged into each other. This led to providing a reasonable number of completely distinguishable and independent propositions. This processing task was challenging as we did not want to lose any interesting and emerging themes through the refinements.

In the next step, we 'sharpened' these propositions (Eisenhardt, 1989) through discussions with experts in the second and third focus groups. These sessions led to a number of turning

points in our initial propositions; therefore, we revised and improved our propositions based on the feedback provided by the experts during these fruitful meetings. Three of the most significant turning points through these sessions are: item-level RFID application; database platform compatibility issues; changing nature of data through different stages of the omni-channel. These topics and the way they contributed to the propositions of the study are explained in the Findings section.

Following Pratt's (2009) guidelines on illustrating the data in qualitative research, the 'power quotes' are provided through the text in the Findings section (section 4) and the 'proof quotes' are illustrated in a separate table as Appendix 1. An inductive approach proposed by Kaufmann and Denk (2011) was used to develop a set of propositions from the evidence collected through the cases.

4. Findings: the challenges of managing omni-channel

Through analysing the collected data from the companies, we have identified five major problems that hamper and influence the achievement and implementation of omni-channel. These challenges are identified as they are the key themes highlighted in the data. The issues and related solutions are explained below, from both business (e.g. manufacturers, retailers, and logistics services) and consumer perspectives.

4.1. Tracing and tracking items

Key issues

The issues related to tracking and tracing products in omni-channel are highlighted by the studied companies. From the business perspective, proper labelling of items is an important element in track and trace which is often conducted by using barcode (for all products) or

RFID tags (for more valuable items) as a reliable tool for identifying every SKU throughout the omni-channel, ideally by using the same unique data label from the point of manufacturing to the retail tills. This however, does not happen in practice, since many companies need to re-label the received products to make them track- and trace-able by their own information system:

"Barcodes are placed at point of origin, for other brands [we need to] often relabel [products] with the [Company H] SKU number." (Company H).

Moreover, although the product remains the same, since it is moved in different load units, (e.g. containers, pallets, boxes) throughout the omni-channel, its logistics-related data vary at different stages.

"Nature of product data changes through different stages of omni-channel." (Focus group 3)

The situations above lead to much manual data handling by companies, including manufacturers and retailers, which is associated with data inconsistencies, errors, and inefficiencies.

From the consumer's perspective, when a product is ordered or returned, the customer often cannot see where the product is until it reaches one of the points through the omni-channel in which the product's label is scanned.

"We don't have visibility of what is being returned until it turns up at the warehouse"... "[after ordering] products go into a 'black hole' until when they are ready to ship." (Company H).

This means a lack of real-time track and trace which is desired by customers as an important element in delivery and return services.

Solutions

Exchanging data between companies in an omni-channel system should be seamless; the handling of data will become less costly and time-consuming if companies use the same labels for identifying products and utilise the same data capturing and sharing protocol as a main enabler of inter-organisational track and trace. For example, if retailers and logistics companies use the same SKU numbers as those generated and used by manufacturers for the same items, this will lead to much less manual data handling, e.g. re-labelling items and creating data files in the information systems. Also, it will prevent mismatches in data regarding the same item recorded in the databases of different companies.

Data standards, e.g. those introduced by Global Standard 1 (GS1) including barcodes and RFID, are currently used in just some parts of the omni-channel systems of the studied companies. In some areas of their omni-channel, other formats for data management are used, e.g. those introduced by major retailers. This situation has led to inconsistencies and inefficiencies.

The other important attribute of an efficient track and trace system is having flexibility for revising data in case of any changes in the items' format and their load units, for instance during logistics operations, and when changes take place in labelling legislation (e.g. showing traceability information about food products to avoid any health incidents caused by allergens).

Usage of RFID instead of barcode is considered by the studied companies due to the advantages it creates for the automation of warehousing or fulfilment processes, as line-of-sight is not required when scanning a label. However, higher costs and issues related to lack of usage by multiple actors across the omni-channel are barriers against using RFID on a larger scale.

According to the highlights above, the first proposition is stated as:

Proposition 1:

(1.a) An efficient/integrated omni-channel system is largely enabled by availability of product track and trace data.

(1.b) Lack of standardised methods for capturing and sharing data in all channels is a major barrier to achieving omni-channel data integration.

4.2. Automation and centralisation level of data management

Key issues

In the studied companies, there are different labels, different technology, and a variety of data sharing protocols used by companies throughout the omni-channels. For example, GTIN by GS1 is used as the product data capturing protocol in different parts of the omni-channels, and EDI is used for sharing data on orders, receipts, and ASNs (Advanced Shipping Notices). However, in case of enquiries, e.g. for traceability checks, all these data are not available in a central database, even in a security-protected format which demands authorisation for access. This leads to time-consuming procedures involving exchanging emails or Excel files which reduces efficiencies in terms of data management.

"The information [about products and processes] exists, but not under one umbrella." (Company E).

The mismatch of data and errors associated with the lack of a central and integrated data system are important issues which affect B2B relationships and companies' reputation as good collaborators throughout the omni-channel.

"Whether we [manufacturer] get anything wrong or the retailer gets something wrong, we tend to get a bad reputation around master data, so anything that can reduce the amount of errors will only help the relationship and take some of the noise out of the system." (Company A).

For customers, lack of visibility on the location of products during different stages of delivery or return, i.e. the 'black hole' situation, is the consequence of such a lack of centralised and integrated omni-channel data.

The studied companies believe that their current information infrastructures are insufficient for supporting B2B and B2C data sharing.

"Currently we manage to pull together overviews of data very manually from across different silos/Excel spreadsheets." (Company G).

This issue was one of the highlighted emerging topics through our Focus Group 3 discussions, entitled 'database platform compatibility'.

Solutions

According to the case companies of this research, there will be great benefit in creating a standard database through which the omni-channel partners can have access to the required data. They believe that having such a database will ensure receiving updated and accurate data about products which are easy to be exchanged, subject to the agreement of companies to use similar labels and data protocols.

Automation of data capturing and sharing, e.g. by using barcode or RFID (enabling higher levels of automation and reading accuracy), helps improve the operations of omni-channel partners by decreasing the amount of time spent on data entry and reducing the human error factors, which are associated with manual recording, copying, interpreting and sharing data.

"Anything that limits the amount of touches in the passing of data, the interpretation of that data is a good thing." (Company A).

An example of automated data handing is integration of order tracking into the ERP systems, which is implemented by some of the studied companies. It has led to creating automatically-generated messages by the information system which have made significant improvements to their administration processes.

Therefore, the second proposition is presented as:

Proposition 2:

(2.a) An efficient/integrated omni-channel system is largely enabled by automation of product data capturing and sharing.

(2.b) Lack of centralisation of product data storage is a major barrier to achieving omni-channel data integration.

4.3. Customer experience in a complex multi-channel environment

Key issues

In the current competitive and growing omni-channel retail market, consumers are increasingly demanding a seamless shopping experience. Examples of this include: fast delivery (even same-day delivery); providing accurate data on retailers' websites about availability of items in their inventory, which prevents the consumer travelling to the shop when the product is not in stock; providing consumers with consistent offers and promotions among price comparison websites, catalogues, online stores and physical shops; and providing easy return for customers without extra costs and hassle. These examples are important customer service elements in omni-channel systems which can lead to elevating or lowering the position of companies in the very competitive e-commerce market.

However, providing such a consistent and pleasing shopping experience is costly for companies because usually it is associated with allocating more resources, and extra logistics and administration costs, for example by offering same-day delivery, free delivery, or free return services to customers.

Consequently, these costs, despite leading to improved customer service, can shrink the omni-channel's products margins, as emphasised by the companies. All the studied companies express their concerns about the costs associated with product returns. The second

focus group meeting points out that there is no profit in selling many items after they have been returned twice.

"Retail supply chains are facing increased pressures for having to respond to multiple channels such as different store formats, discounters and also the pure play operators which has led to the inevitable consequence of increased costs and tighter margins." (Company D).

Solutions

Companies and also experts in the focus groups believe that enabling customers to make decisions in different processes, e.g. by providing them with a variety of methods of purchase, delivery options (e.g. home-delivery, click-and-collect, or a collection centre), and return options (to return the product by posting it back, or exchanging it in a store when it has been purchased online, or vice versa) is the key to the success of companies in consumer-driven omni-channel retailing. However, this increased power of consumers and elevated responsiveness of omni-channel systems is costly for companies because it demands multiple stock keeping points, quick delivery of products, and multiple shopping facilities, all of which may increase operating costs significantly.

"Instead of having sophistication in SC, let's have it in the customer-facing end to help drive customer decision-making in a way that smoothens the physical flows without compromising what customer wants. It will expose which are the profitable fulfilment routes to customers, including returns rates, etc." (Company E).

According to the studied companies, a large part of such costs can be reduced subject to collaboration of companies in terms of sharing data through standardised methods and connections to different nodes in the omni-channel which enables moving the products to the point where they are demanded more by consumers. For examples, when for the same product there is a too high inventory level in the online DCs while the stores are running out

of that product, instead of referring customers to purchase online, companies can move a part of the online inventory to the stores, leading to a pleasant customer experience, and also a lower level of inventory costs and tied up capital for the whole omni-channel system.

Thus, the third proposition is formulated as:

Proposition 3: *The omni-channel's data management adjustability to the customers shopping needs and products physical flows enables omni-channel data integration.*

4.4. Manufacturers' role in data management

Key issues

Depending on retailers' requirements and their offers to their customers, manufacturers need to be ready to make their products available to different channels' needs, to ship and deliver them, and to provide after-sale services through various channels. Moreover, manufacturers should try to build their own direct channels to customers, providing them with product information, direct purchase facilities, and after-sale services. Managing all these tasks coherently and consistently, added to the traditional manufacturing responsibilities, is a huge challenge for many manufacturers. It usually goes beyond coordinating multiple tasks, and needs a comprehensive set of activities, such as capacity planning, material management, and transport planning within the manufacturing firm and across its supply and demand chains.

Another requirement for manufacturers is taking more responsibility for creating and managing product data to be used by other companies in the omni-channel, including retailers, logistics companies and even consumers.

"At the moment retailers are putting pressure on suppliers to take more responsibility for master data set up, ordering all of those transaction elements of the supply chain. A lot of the time it can feel like task transfer as they are trying to reduce costs; at some point there needs to be some change that enables greater efficiency end to end." (Company A)

Solutions

As the most informed companies about products, manufacturers are in the best place to create the master data about each SKU. Subject to using the same product labels and data storage and exchange protocols (explained before), these data created by the manufacturers are to be used by retailers. Although some manufacturers might feel increased pressure on themselves regarding this data management task in new omni-channel environments, this responsibility will lead to more integration and higher efficiency of the whole omni-channel system, which leads to total cost reductions and improved customer service as competitive advantages.

Therefore, proposition 4 is:

Proposition 4: *Extending the omni-channel's data management to manufacturers and their internal information systems enables omni-channel data integration.*

4.5. Connecting the production and sales with the logistics and delivery services

Key issues

Information generated by different companies, from manufacturers (creating master data) to the logistics companies or warehouse operators (generating logistics data) needs to be integrated in different stages of the omni-channel in order to provide a sufficient 'data package' about the product and the processes which it has gone through. As mentioned before, this is labelled as the "changing nature of data through different omni-channel stages" by the focus group's experts.

This integration is a challenging task in omni-channel systems, due to lack of compatibility of databases of different companies and also even lack of desire for collaboration and open information sharing among them. This lack of integration and compatibility of information

systems creates a need for data exchange (or feeding) between manufacturers/retailers and logistics companies.

"Our internal track and trace is all managed through SAP [the ERP system], but XYZ1[i] *[delivery company] use their own track and trace"…"We have EDI set up with 3PL to feed data into whatever WMS system they are using."* (Company F).

If the data are not completely shared then customers will face a 'black hole' when tracking and tracing their purchased items. This data exchange is a significant issue that may affect inter-organisational relationships between the manufacturers/retailers and their logistics companies in such a way that too much dependency is built into the logistics company. According to the studied companies, the potential disruptions and costs of switching their logistics service providers can be so high that it becomes the main reason for them to stay in contract with their service provider despite not having ideal terms of collaboration with them.

"Customer home delivery orders go out by XYZ2[ii] *currently. They use an Access database from warehouse to manage online orders. They wanted to switch courier to Hermes but the Access database can't integrate … so [they] stuck with XYZ2*[ii]*."* (Company G).

Solutions

Consistency in messaging and accuracy of information about products and logistics processes are crucial for integration of omni-channels. One example is the ASN information put on the pallets which should be the same as the ASN messages sent to the receivers of cargo. Such improvements in accuracy and consistency of logistics data improve efficiency of operations and reduce the demand for a high amount of checks and corrections.

Information sharing between suppliers and retailers becomes much easier if logistics service providers, as intermediaries between them, can communicate messages (e.g. regarding

product changes) to the retailers. Using the same product labels and data sharing protocols can reduce the issue of lack of compatibility of databases.

Therefore, proposition 5 can be stated as:

Proposition 5: *Including logistics services and their relevant data in the omni-channel's data management enables omni-channel data integration.*

See Appendix 1 which shows the proof quotes, supporting the key issues and solutions related to each proposition. Figure 1 formalises the five propositions above into a theoretical framework which outlines a number of building blocks and forms a basis for omni-channel data integration.

[Insert Figure 1 here]

Omni-channel data integration, which is implied as an ultimate objective in all the propositions, is shown at the top of the framework. Extracted from propositions 1 and 2, four data management features of (i) Product track/trace data availability, (ii) Standardised methods for capturing and sharing data in all channels, (iii) Product data capturing and sharing automation, and (iv) Centralisation of product data storage, are recognised as the basis constructs of the framework. They indicate the fundamental role of data availability, standardisation, automation and centralisation for omni-channel data integration. Propositions 3, 4 and 5 recommend extending the scope of omni-channel data management to manufacturers, consumers and logistics services. They are shown as the pillars of the proposed framework, indicating how the data management features (i.e. data availability, standardisation, automation and centralisation) may enable omni-channel data integration.

5. Contributions

The paper provides a number of theoretical and practical implications which are presented in the next sub-sections.

5.1. Theoretical contribution

This paper has explored the complex features and dynamics of omni-channel, and has recommended solutions for overcoming challenges against development of omni-channel, through data integration. Accordingly, the main theoretical contribution of this paper is introducing the enablers and barriers to achieving data integration in omni-channel. The outcomes of this research indicate that data capture and data sharing are key enablers for omni-channel data integration. Furthermore, this research shows that the omni-channel's data management expansion towards customers, manufacturers and logistics services enables omni-channel data integration. This expansion takes place when omni-channel data becomes adjusted according to customer changing needs, and manufacturing data, as the main source of product data, becomes connected with logistics data to synchronise the omni-channel physical integration with data integration.

This paper also contributes to the literature by identifying the lack of data standardisation and centralisation as the major barriers to omni-channel data integration.

These outcomes extend existing knowledge in the relevant recent literature (e.g. Bradlow et al., 2017; Herhausen et al., 2015; Kembro and Norrman, 2019; Musa et al., 2014; Oh et al., 2012; Park and Kim, 2019; and Zhang et al., 2018) by specifying and elaborating some key enablers and barriers of omni-channel data integration.

5.2. Practical contribution

E-commerce is still emerging in practice, as most companies are able to sell their products online. This has made it a necessity for companies to implement at least the basic levels of multi-channel or omni-channel systems. However, many companies (e.g. those studied in this paper) find this transition from conventional towards omni-channel business quite challenging. A large part of the problem is related to the integration and data management issues, as highlighted in the Findings section. This study provides very useful insights for practitioners, by providing guidelines on how to achieve a seamless flow of material through omni-channels, considering the complexities which are added to these networks due to increased consumer choices for products, product deliveries and product returns.

In summary, from a practical perspective, the benefits of integration for manufacturing companies and retailers include increasing the quality of product data and transaction data, enabled by using standards and technology for data capturing and data sharing. Reducing the mismatches of data stored in different databases of actors in omni-channel systems is another improvement which can be made through integration achieved through enhanced data management. This can lead to significant reduction of the costs incurred for low quality of data, e.g. inventory costs.

For customers, data integration in omni-channels means a seamless shopping experience. It enables manufacturers (brand owners) and retailers to provide higher levels of service to customers by providing them with several alternative options for buying and returning products via different channels.

Implementation of an integrated omni-channel needs specific levels of collaboration of companies (including manufacturers, retailers and logistics companies) in sharing data. Besides technical aspects, enabling collaboration between the actors might demand inter-

organisational trust and within-organisational change management, which may make companies slow in implementing fully-integrated systems. Such barriers can be even more difficult to overcome when manufacturers and retailers are in competing positions, e.g. when manufacturers sell their products directly to customers besides selling them via retailers.

6. Conclusions, limitations, and future research

This study explores the integration of omni-channel from a data management perspective. Through studying ten leading UK companies, we generated a number of propositions on enablers and barriers to omni-channel data integration to help improving operational performance of omni-channels. Our findings highlight the importance of automation of data capturing and sharing methods, and centralising data storage as ways of decreasing inconsistencies in data among companies and channels. These can lead to enhanced track and trace capabilities which improve efficiencies in terms of time and cost when it comes to managing transactions in networks. The omni-channel supply chain should be adjustable according to customers' needs and decisions. Integration of logistics service providers' information systems into their buyers' systems is crucial in making omni-channels more efficient and consumer-responsive.

This research, as an explorative study, includes a number of limitations. First, it mainly focuses on a limited number of cases in one country (the UK), and its scope was largely narrowed to product flow data (i.e. product, delivery and distribution data) – not the customer data – in the omni-channel. Therefore, future studies on customer data (e.g. shopping behaviour, demand patterns, sales trends, and product/delivery preferences) in the omni-channel integrated systems can develop this research. Moreover, to expand and generalise the outcomes of this paper, further studies in the form of surveys with a large number of

respondents are needed. Studying companies from other countries or continents, e.g. in the form of comparative case studies, can lead to providing interesting insights about developments of integrated omni-channel systems in different parts of the world. In this study the inter-organisational issues related to implementing integrated omni-channel systems, such as trust, change management, and aligning inter-organisational experiences were not explored. These areas also demand further exploration in the form of qualitative and quantitative research.

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Figures

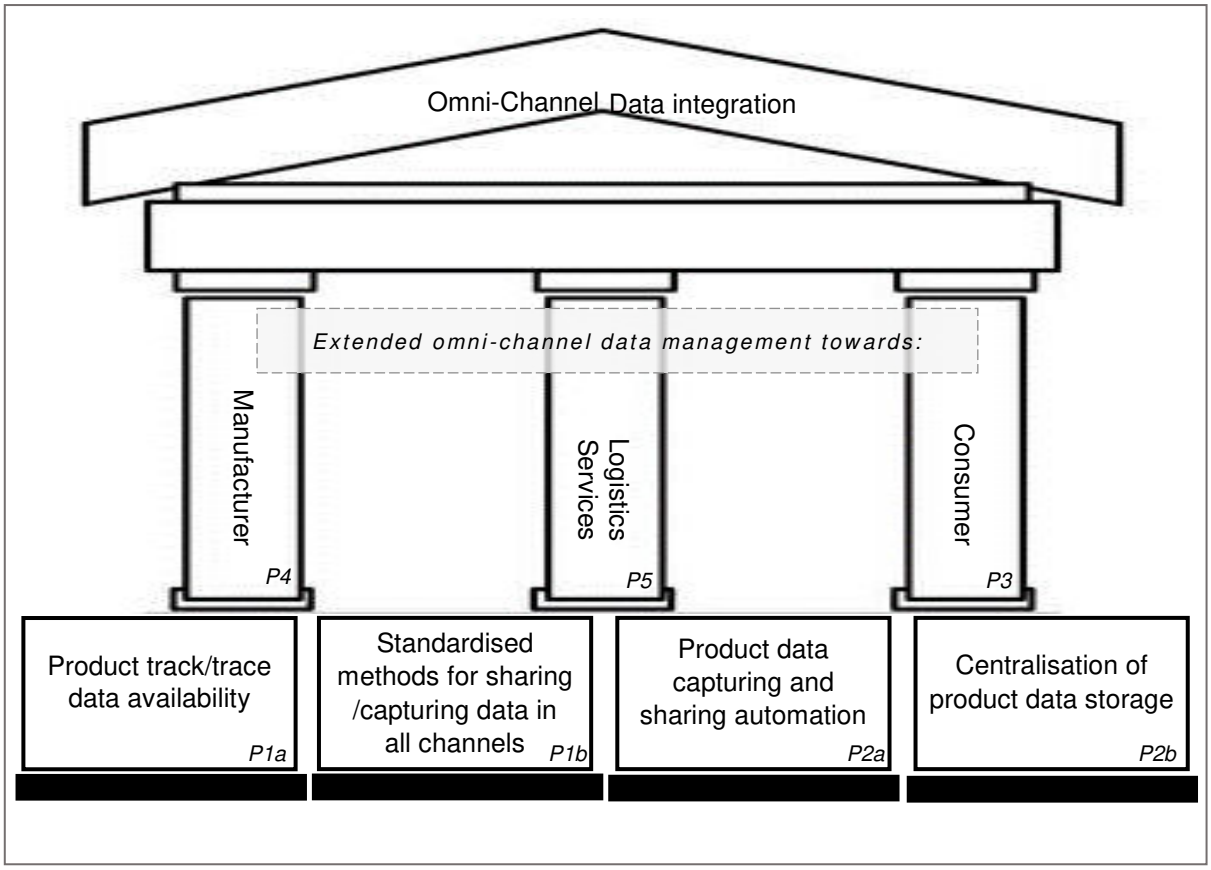

Figure 1. Theoretical framework: research propositions that address the key issues identified for the omni-channel systems.

Tables

Table 1. Omni-channel integration types according to the literature.

Integration type	***Description***
Integrated market information	The sources, channels and interfaces of market data and promotions (e.g. market trends, customer information, and sales plans) should be linked and synchronised (Småros et al., 2003). Integration in market and promotion information supports demand visibility. Availability of demand data from different channels helps the omni-channel system to manage product flows more effectively (Wollenburg et al., 2018).
Integrated product information	Providers and distributors of product information (i.e. the product's technical, physical, component, or ingredient data) should work collaboratively with shared product information resources to make sure that the same information about every product is shared with all members of the omni-channel system as well as customers (Lim et al., 2012; Musa et al., 2014).
Integrated transaction	Involving payment instruments such as cash, cheques, cards, coupons, gift cards, postal orders and electronic transfers, and their linkage to authorisation methods such as PIN number, verification code, and signatures (Carton et al., 2012). It may also imply a secure accessibility to customers' transaction data via various channels, i.e. availability of payment data of individual customers to the relevant parts of the omni-channel system.
Integrated pricing	Synchronising the products' prices across channels and making changes in them visible for customers and other members of the omni-channel system (Oh et al., 2012).
Integrated order fulfilment	Involving many activities, carried out through various channels and by different parties to enhance trackability, traceability, and changeability of product, customer, and their relevant orders. It also includes the inventory status and location information, which should be accessible and retrievable across the omni-channel system (Ma et al., 2014).
Integrated customer service	The same or compatible service standards should be delivered by all members of the omni-channel. Hence, all service providers should be aware of the customer expectation and the required service standards (Das and Chowdhury, 2012).
Integrated reverse logistics	The link between different stages of reverse logistics and different channels involved in it needs to be created in a way that information around the return points, stock keeping points, and products reverse flow (Marchet et al., 2018) should be retrievable, traceable, and changeable (Oh et al., 2012).

Table 2. Case companies and their main omni-channel highlights.

Company	***Type of company***	***Sector***	***Channels through which products move***
Company A	Manufacturer	FMCG	Home-delivery, click-and-collect, mobile shopping via various retailers. Also, direct online selling and shipment of some product ranges to consumers via the company's website.
Company B	Manufacturer	Food	Home-delivery, click-and-collect, mobile shopping via different retailers.
Company C	Wholesaler	Food	Products made by manufacturers (including Companies A and B) are distributed through Company C as an omni-channel stakeholder.
Company D	Retail chain	Food	Physical stores, home-delivery, click-and-collect.
Company E	Retail chain	Upmarket items	Physical stores, home-delivery, click-and-collect.
Company F	Manufacturer and retail chain	Footwear	Home-delivery, click-and-collect, mobile shopping via various retailers or via own-branded stores of the company.
Company G	Retail chain	Clothing	Home-delivery, click-and-collect, mobile shopping via various retailers or via own-branded stores of the company.
Company H	Online retailer	Fashion and beauty	Only online selling and home-delivery.
Company I	Retail chain	Fashion and clothing	Home-delivery, click-and-collect, mobile shopping via various retailers or via own-branded stores of the company.
Company J	Retailer	Fashion and clothing	Physical stores, home-delivery, click-and-collect.

Table 3. Data sources and their contribution to the findings of the study in chronological order.

Data collection in sequential order	***Details***	***Aim and contribution to the findings of the study***
1. Focus group 1	- With 2 researchers and 8 experts. - Took place before starting the interviews. - Lasted for 5 hours and led to 18 pages of notes.	Increasing the knowledge of the researchers about the issues related to omni-channel integration and data management. Helping to identify the most appropriate sectors and companies to be studied.
2. Interviews	11 interviews, making 145 pages of transcripts and more than 850 minutes of recorded conversation, including: - 9 Semi-structured face-to-face and telephone interviews with representatives from 8 companies. - 2 completed interview forms by 2 representatives from two companies.	Providing knowledge about the companies' channels and data management methods, and the development level and challenges of implementing their omni-channel systems. Leading to initial propositions to be discussed in focus groups 2 and 3.
3. Documentation	- 19 articles by leading industrial press published between 2013 and 2018, containing 148 pages in total. - 12 company websites - 38 internal reports published by the companies containing 420 pages. - 12 annual reports containing more than 1,100 pages.	Complementing the data collected via interviews, and helping to identify the level of omni-channel practices conducted by the companies compared to their competitors. Providing general information about the companies, e.g. their turnover, growth, number of employees, global presence, and the channels through which they sell products. Providing information about omni-channel related initiatives, practices or projects conducted by the companies.
4. Focus groups 2 and 3	Focus group 2: - With 2 researchers and 7 experts - Conducted after completing the interviews - Lasted for 4 hours, generating 23 pages of notes. Focus group 3: - With 2 researchers and 8 experts - Took 4 hours and led to creating 12 pages of notes.	Second meeting: Enabling the researchers to share the findings of the interviewees in the session and to receive feedback and additional information from the experts about the discussed topics. Third meeting: Enabling the researchers to present the initial propositions and to receive feedback on them, leading to revising and improving some of the propositions.

Table 4: The list of companies who participated in this study and the sources of data that they provided.

Company	Data sources provided
Company A	- Telephone interview with Head of Global Customer Logistics. - Documentations including company website, archival records and annual records - Industrial press articles
Company B	- Telephone interviews with Business Excellence Manager/Data Standards & Data Management and Head of Supply Chain - Documentations including company website, archival records and annual records - Industrial press articles
Company C	- Telephone interview with Head of Technical Team - Documentations including company website, archival records and annual records - Industrial press articles
Company D	- Telephone interview with Supply Chain Manager - Documentations including company website, archival records and annual records - Industrial press articles
Company E	- Telephone interview with General Manager - Documentations including company website, archival records and annual records - Industrial press articles
Company F	- Telephone interview with Supply Chain Manager - Documentations including company website, archival records and annual records - Industrial press articles
Company G	- Face-to-face interview with Stock Distribution Controller - Documentations including company website, archival records and annual records - Industrial press articles
Company H	- Face-to-face interview with Head of Supply Chain Development - Documentations including company website, archival records and annual records - Industrial press articles
Company I	- Completed interview form by Supply Chain Manager - Documentations including company website, archival records and annual records
Company J	- Completed interview form by Head of Supply Chain Team - Documentations including company website, archival records and annual records
Company K	- Focus groups by 6 experts: o Business Consultant o Consultant o Consultant o Director o Supply Chain Solutions Manager o Market Development Manager
Company L	- Focus groups by 2 experts: o Management Consultant o Management Consultant

Table 5: The keywords used for coding analysis and their description according to the literature.

Keyword	***Description***
Integration	The degree of linkage and coordination of omni-channel system at different levels, including ease of flow of items through channels, communication of databases, seamless information flow among channels and companies involved in them, and coordination of business processes (Chen et al., 2015; Oh et al., 2012).
Data management	The degree to which data are analysed and sorted in order to support accurate evaluation of business functions and correct decision-making about products, processes and choice of channels (Li et al., 2015; Lim et al., 2012).
Data sharing	An aspect of connectivity of a company, achieved through technology-enabled linkages across its supply chain (or omni-channel system), from upstream to downstream (Fawcett et al., 2009; Welker et al., 2008).
Data mismatch	Lack of synchronisation between the data stored in databases and the actual facts about operations of a company, which can cause negative impacts on the costs and efficiency of omni-channel operations (Haug et al., 2011).
Complexity	Factors such as high variety of products and high requirements for variability of fulfilment methods and processes which make management of a supply network challenging (Gimenez et al., 2012; Saghiri et al., 2017).
Visibility	The level and timeliness of information provided about material flow from suppliers to customers in a supply network (Delen et al., 2007)
Collaboration	Joint initiatives between companies in a supply network, e.g. data sharing via EDI between retailers and their suppliers, which lead to improving efficiency of their operations (Jiménez-Martinez and Polo-Redondo, 2001).

Appendixes

Appendix 1: Proof quotes related to each proposition selected from the interview transcripts.

Propositions	***Selected relevant proof quotes from the interviews***
Proposition 1	• *"[using] bar codes on every traded item that we sell [is] fundamentally important to the business in ensuring that we can handle the products through the distribution chain, right the way through the tills."* (Company C) • *"… [the product] has got the right bar code, does the information on the product match what is on systems and … if the measurement of the product is accurate to what is actually on the system and is transferred with a trading customer."* (Company B) • *"The main reasons for product reject is that the bar code set up on our internal product file does not match what is actually on the product."* (Company D) • *"I would say 20-30% of the standards that they are looking at within reduced check is from GS1 [Global Standard 1], the rest is all XYZ3*[iii] *standards, so there's going to be foundation stuff … like ASN's, SSCC's [Serial Shipping Container Code], bar codes, that just has to be consistent across all the retailers, guess what there isn't, it's a bit of a mess, even their implementation of it is a bit of a mess."* (Company B). • *"[We should] focus on management of the data, management of the attributes so that if things like the pack size changes, the case format changes, formulation changes, if there's any legislation that we experience like the food industry and labelling regulations that came into force … all the systems that the supplier has…comply [with these changes]."* (Company D) • *"Barcodes enable semi-automation… [and] RFID would give more 'warehouse' style stock accuracy on the shop floor which will improve fulfilment". "Hierarchies of scanning from unit to box to pallet to truck [is done by barcode and] we would like to do the same with RFID where appropriate.*" (Company E)
Proposition 2	• *"To date there has been limited IT infrastructure investment. The till systems are old – not omni-channel enabled."* (Company G) • *"The information [about products and processes] exists, but not under one umbrella [using the same standard for data capturing and sharing]…GTIN [Global Trade Identification Number by GS1] is fundamental to many scanning processes. EDI is used for orders, receipts and ASNs [Advanced Shipping Notices]."* (Company E) • *"The challenge in our industry is that no one retailer generally has been willing to follow the standard and everybody keeps pedalling their own format so you have to duplicate the interfaces…"* (Company H) • *"…it would be for sure a big benefit if we're only updating a standard database for the trade."* (Company H) • *"Making sure that information is aligned and all the data that we have on our system is correct will benefit our supply chain because it means we can flow products more effectively and also understand what that product actually is."* (Company D)

	• *"Track and trace are all managed through SAP [their ERP system]. Production is all managed in SAP [as well] – [which means] any delay in production orders tie in with POs and flag any projected delay."* (Company F)
Proposition 3	• *"Both retailers and suppliers need to meet consumers' expectations for having an integrated and more personalised shopping experience." (Company D)* • *"We need to identify opportunities to drive efficiencies through the end-to-end supply chain by increasing trust and confidence in product and information flow and also by improving the shopper experience through greater certainty and confidence in the accuracy of product information and fulfilment processes throughout the entire retail supply chain while increasing compliance with regulatory demands."* (Company A)
Proposition 4	• *"We have to respond to each of these channels, different formatted stores, discounters, pure plan and so on, and the view here of course is that initiative trading partner collaboration will give a critical success factor in the new omni-channel environment."* (Company A)
Proposition 5	• *"We have EDI set up with 3PL to feed data into whatever WMS system they are using."* (Company F) • *"Supplier contacts the merchandise team and gives an authorisation number. There are no ASNs."* (Company H) • *"For instance, ASN [advanced shipping notice] is an area or process that we're looking at. The information on the pallet before it leaves the warehouse [should be] the same as the information that's been sent through the ASN message. So, there are process checks that you can have in place to ensure that the right information is going to the customer at the right time."* (Company B) • *"I suppose from a supplier's point of view if you're able to inform one third party as opposed to all your different customers that would make their lives easier and the third party would have a more efficient way of communicating product changes to its retail base."* (Company D)

Endnotes:

i. A major logistics company in the UK. The name is not shared for confidentiality reasons.

ii. A major logistics company in the UK. The name is not shared for confidentiality reasons.

iii. A major retailer in the UK. The name is not shared for confidentiality reasons.

Authors' biographies

From ambition to action: How to achieve integration in omni-channel?

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